SCIENCE AND FAITH.[1]

II. INTRODUCTION TO MAN AS A MEMBER OF SOCIETY.

MAN, as scattered over the surface of the globe in clans, tribes, and peoples, forms the subject of ethnical anthropology or ethnology, just as man viewed as an animal forms the subject of anthropology proper or zoölogical anthropology. United politically under one flag these groups take the name of nations or nationalities. Viewed as to their modes of thinking and their methods of satisfying their wants they bear the name of civilisations. Considered in the relations which individuals bear to the group as a totality they bear the designation of societies. Sociology is the science which treats of societies. There is an animal sociology and a human sociology.

Conformably to the principle laid down in our preceding article,[2] that man is merely one of the exalted, or rather the most exalted, of the forms of animal life, and that the laws which regulate his existence, the phenomena which he exhibits, and the organs which constitute his being are, *in form and degree approximately*, but the application, repetition, and development of those which we meet with in the different stages of animal evolution, we shall commence with animal sociology. This part, accordingly, will form a transition to a third and last in which we shall treat man as a member of society. It will enable us to dwell at length on certain points

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[1] Translated from Dr. Topinard's MS. by Thomas J. McCormack.

[2] *The Monist*, Vol. VI., No. 1, October, 1895, p. 28.

which we were obliged to curtail in the preceding article. We shall divide it into three chapters: (1) preliminary biological data; (2) the animal family; (3) animal societies.[1]

I. PRELIMINARY BIOLOGICAL DATA.

Life reduced to its simplest expression is the resultant of an *ensemble* of properties or operations of a peculiar species of substance called protoplasm, which impregnates all the parts of organisms and which we meet with in the isolated state only in moners. The four first properties which must be signalised are: (1) the *oxidation* of protoplasm, which is the source of its energy or stock of vital power; (2) *excitability* or *reflexibility*, which gives rise to its actions and is the intermittent cause of its loss of energy; (3) *nutrition*, which maintains the integrity of the protoplasm and is the cause of its increase; (4) *reproduction*, which supervenes when the augmentation has reached a certain limit. The result, as regards the protoplasm, may be summed up in two words: *life* as an individual during a certain period of time, and indefinite *perpetuation* in forms similar to itself. M. Delâge adds a third characterisation: the performance of *work*. These four properties, viewed alone, are physico-chemical in character. If a particle of matter, for example, comes within reach of a moner, an excitation takes place. If the particle is nutrient in character, the pseudopods of the moner will be extended, its cilia will be set in motion, and the nutrient particle will be engulfed. There is nothing mystical in this performance. A property merely is put into play—a reaction succeeding an excitation. At most we might say that the centrosome acted as the centre of attraction.

But reduced to their ultimate properties protoplasmic substances are simply inert bodies—admirably constructed machines operating in an analogous manner but without coal or actual materials to work upon. Their impulse and direction are furnished by outward stimuli. They are constrained to respond to the commands

[1] The first two of these chapters constitute the article in the present *Monist*. The third will appear in October, and the concluding *part* in 1897.

imposed upon them, to put themselves in harmony with stimuli offered, in a word, to obey the exactions of their environment agreeably to the law of necessity, and on pain of death to accommodate themselves to the conditions of existence in which their lot is cast. Hence results a fifth property of protoplasm—that of *adaptation.* Three factors unite in insuring the perfect action of this property. (1) The plasticity of protoplasm, the result of the joint action of its reflexibility and nutrition; (2) its slight variations, with the consequent chance of modification; and (3) its capacity for transmitting new peculiarities. A word as to the first two of these. Simple and regular as the vital acts of protoplasm *per se* may be, they involve nevertheless more or less perceptible differences. Nutrition has its irregularities. The nutrient particles are not always seized and ingested at equal intervals of time nor always on the same side. The elaborated products are not always disposed with perfect uniformity from the circumference to the centre. *Variability* thus appears a primitive property. As to transmission, or *heredity*, it is involved in the fact of the reproduction of individuals like the parent protoplasm, as it exists at the moment. Thus we have another primitive property.

Nor is this all. From the union of all these properties, now numbering seven, but more particularly from the growth of the protoplasm, from its repeated reproduction or multiplication, and from its adaptation, results not the last, but the most fecund and the most general, of the primitive properties of protoplasm—its power of indefinite development, that is evolution.

Evolution! Without which living beings on our planet would never perhaps have emerged from the unicellular state, and which has caused the growth from the protists, of the vegetable and animal kingdoms, and of the vertebrates and man; titanic power always in action, always alert, profiting by the least circumstance, yet whimsical, capricious, seemingly groping and without set purpose,[1] em-

[1] The sole objection to this manner of conceiving evolution is that which I have already set forth in my *Elements of General Anthropology*. Certain organs, or arrangements of organs, certain functions are alike, or are developed in the same direction, in different branches of the animal tree, although the common trunk from

ploying the most insignificant means and neglecting at times the most direct, pursuing different lines in its advance, curved lines, straight lines, crooked lines, parallels, divergents, yet frequently arriving at the same result, limited only by absolute impossibility for the time being, having but one guide, that which is good and directly useful to the individual, and but one sanction, success! Was not that what the divine author of Genesis strove to express when recounting how the heavens and the earth and the plants and the animals had been created, he stopped at each stage, and before continuing said: "And God saw that it was good."

The first results of evolution affect the interior of the protoplasm. Granulations, a nucleus in the vicinity of the centrosome, one or several vacuoles, perhaps filaments, make their appearance there. The moner has become an amœba, which is classified as a protozoön or a protophyte, according as it leans towards the animal or towards the vegetable kingdom. Some years ago a considerable group of homogeneous protoplasmic bodies without nuclei were supposed to exist; but the increasing power of microscopes has steadily reduced the number of these, and we are now constrained to conclude that few primitive protoplasmic bodies have come down to us. The following effects of evolution relate to the exterior: the pseudopods, the cilia, the vibratile filaments, the various irradiations, the more or less viscid envelopes, and even the calcareous or silicious teguments, which other divisions of the kingdom of protists present.

But the decisive stage in this distant epoch of the history of the animal kingdom is that which turns to account a final and hitherto latent property of the protoplasm, its power of blending or aggregation. This occasionally occurs in the protists. Protoplasmic bodies, with or without nuclei, born by the ordinary method of scission, adhere by their pseudopods to the bodies which have engen-

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which they have diverged presents no trace nor prophetic germ of them. To this I reply that these organs or functions being good and useful, it is natural that evolution should have led up to them several times by different paths. It is thus that prehistoric men, not in communication with one another and of different races, have independently invented flint-edged instruments or erected menhirs.

dered them, or detach themselves therefrom, to form afterwards aggregated masses. Others having been left at liberty for a time, encounter one of these aggregates and join it. Thus appears at the beginning of our research this grand property of association whose fortunes and development we have now to follow. By virtue of it the metazoa succeed the protozoa; multicellular, unicellular beings. By it, all the numerous animals that inhabit our planet have been built up from the simplest to the most complicated, progressively to the vertebrates and man. Association, and adaptation by differentiation within the associated groups, are undeniably the two most potent factors of evolution.

Without inquiring into the relation which the species of association now under discussion, which is at once morphological and physiological, bears to that which we encounter under the specific name of *societies*, we will continue our investigations and cast a glance at the phenomena which the first kind offers.

The first aggregates, the so-called animal colonies of naturalists, were undifferentiated. All the cells were alike and constituted so many distinct individualities arranged in simple juxtaposition. Upon their first entrance into the kingdom of the metazoa, where henceforward they bear the name of plastids or anatomical elements, these cells were placed in conditions of life, which varied by reason of their different situations within the aggregate, and each cell was constrained to adapt itself to this situation. The first differentiation of their mass and the one which was most urgent, was effected at their centre, where a digestive cavity arose; the next was effected in the walls of this cavity which were doubled, the external layer being in contact with the circumambient medium, and the internal layer with the water which penetrated the cavity, both acquiring the special character which their functions demanded. Olynthus, a primitive sponge, is an example. The second adaptation is in the various forms which this primitive plan is led to assume according to the circumstances of its condition, becoming elongated or ramified as it is in polyps, or taking some other form. One of the extremities, that which is in contact with the ground, becomes attached to the ground; the other, the free extremity of the cavity,

or digestive tube, provides itself with tentacles and becomes the mouth. The primitive cells, conjoined in groups, have thus given rise to distinct sorts of individuals which have been denominated according to their functions, digestive, prehensile, fixative, etc. Quatrefages has counted as many as seven kinds, not including the cells of junction or indifferent cells, which in some polyps are formed in sheets.

So far we have had nothing but the application of the grand law of necessity: adaptations to the conditions of the environment or death. Every plastid or group of plastids is subject to the exigencies which its situation brings with it. Morphological differentiation, that which is most favorable to the tasks imposed, is spontaneously effected. Every group is individualised in the functions which are allotted to it. Each has lost in a corresponding degree its ability to discharge other functions, and has been supplanted in their performance by its neighbors which it in turn has supplanted in theirs. Some of the cells of the community have obscure parts to fill. The parts of others are leading, and necessarily the latter take the supremacy. The inequality between the members of the colony is striking, but it is in the interest of the common weal. Solidarity is the result,—a solidarity which cannot help augmenting at the expense of all the individuals, but especially of the less useful, and which tends to culminate in the general unity of the whole. When this point is reached, our adapted and solidarised[1] colony forms throughout all its parts a single organism only,—an individual which has taken the place of all the old, minor individuals which are now fused and lost in its midst. This is the *meride* of Prof. Edmond Perrier.

The animals comprised under the designation merides are all metazoans, more or less low in the scale. Their young migrate and become fixed elsewhere, or live at liberty, or adhere together, thus laying the foundation of a new species of colony of the secon-

[1]At the suggestion of M. Topinard we use throughout this article the words *solidarise*, *solidarisation*, etc.; no existing English words have the exact meaning of the French equivalents of these neologisms, which have their justification and their analogue in *solidarity*.—*Tr.*

dary degree, the members of which pass, or at least may pass, through the same stages of development. The colony augments and is differentiated; its parts become consolidated, and the whole again forms a single organism, a colonial individual. This is the *zoöid* of M. Perrier.

In their turn, these zoöids lead independent lives as distinct and ambulatory individuals, or they gather together in groups and by coalescence give rise to colonies of the tertiary degree. More complex adaptations than the preceding, yet analogous thereto, arise. The parts not only adapt themselves to the external conditions, but also to one another. Fusion, atrophy, and overlapping of organs result. Solidarity and harmony are established, and the result is again a single organism—the *deme* of M. Perrier. The higher invertebrates and all the vertebrates are demes. The human organism is a deme, that is to say, a consolidated colony of zoöids or zoönites of which the initial cellular aggregates are represented by anatomical elements.

Merides, zoöids, or demes; colonies of plastids, of merides, of zoöids, or of compounds thereof; colonies of elements of what degree of individualisation or solidarisation soever, all depend on the varied conditions of existence in which they are placed. In the higher animals the factor which seems to have the most influence is food. In the lower and middle invertebrates, it is difference of habitat and hindrances placed in the way of free development of parts. The animal is fixed or natant; it crawls about in the water, in the mud, or creeps about upon the earth. Of all the circumstances most favorable to its evolution and perfection, the first, beyond dispute are unrestricted liberty and struggle of the liveliest sort. Fixed colonies, says Perrier, never become completely transformed into individuals. Colonies which at liberty have attained a certain development, retrograde if they become fixed. Such is the predicament of the ascidians, which through having immobilised themselves have fallen from the rank of vertebrates to that of worms; and it is also the case with anatifa, the stalked barnacle, which is a degenerate crustacean. Among the causes which produce deviation of development is the formation of squamous valves, of a tubular

or spiral calcareous case—the compressed parts atrophying. Another cause of deviation is parasitism. Certain zoöids or colonies of zoöids, on coming into media where life is easy and food constantly at hand, lose nearly all their organs except their digestive tube, and are practically reduced to the apparatus of reproduction. Slave-holding ants, becoming wholly incapacitated for self-support, die when deserted by their slaves. And yet these degenerate species on being restored to favorable habits regain their power of evolution in any direction. This is universally the case with ascidians. When they have attained their liberty they give birth to exuberant colonies called pyrosomes.

There is left us from our survey this fundamental fact. If evolution is to be profitable, progressive, and productive of its best results, the individual must conserve its full liberty, must possess its full power of reaction; in other words, for obtaining the normal play of the conditions of existence, no hindrance must be interposed. As the economists say: *laissez faire, laissez passer.*

In sum, evolution beginning with primitive protoplasmic bodies, has produced the metazoa by following five directions and proceeding from five sources. As enumerated by M. Edmond Perrier these are as follows: the larva of the sponges, the planula of the polyps, the gastrula of the echinoderms, the nauplius of the arthropods, and the trochosphere of the worms, from which are descended the vertebrates, and consequently man. This gigantic work was accomplished during untold ages substantially by means of *association* with its attendant consequences—division and specialisation of labor, functional and then morphological differentiation, reciprocal adaptation of parts, and finally their solidarisation, culminating by progression in unity.

Let us return to one of the primitive properties of protoplasm, to its excitability or reflexibility. In fact, this may be subdivided into two properties, as the preceding designations indicate. An infusory or organic debris passes in front of a moner and an excitation is produced: the matter is seized; this is reflexibility or reaction. Subsequently, on the protoplasmic substances or cells becoming aggregated, these two properties are combined and pass through the

same stages as association. Like the latter they are differentiated according to position and according to needs. They partake of the fortunes of the different groups or individuals, which are here digestive, here reproductive, there nutritive, and there prehensile. They become severally strengthened in their distinctive characters, and appear in various forms. Excitability becomes buccal, visceral, tegumentary, exploratory, locomotor, or general sensibility. Reflexibility is made to harmonise with different sorts of corresponding reflex movements.

But physiological differentiations cannot persist without being followed by morphological differentiations. In the protoplasm or cell there is nothing material to indicate a differentiation of the two properties. At a certain stage, the repetition of the same impressions and of the same acts forcibly compels certain plastids to adapt themselves to the double rôle, and thus gives the impulse to their transformation. Thus are born, at this spot and at that, the first nervous fibres and nervous cells—fibres for the transmission of impressions or reactions, and cells as an intermediate focus of reflex action. This step accomplished, the rest proceeds of itself. The cells by association and multiplication become ganglia, the fibres nervous cords. The most active, the most necessary ganglia assume the hegemony. Each meride, each zoöid in a radiate or linear colony has its own ganglia. Their mutual adaptation is accomplished in the most favorable manner agreeably to the principles of necessity and economy; the superfluous ganglia disappear, others are newly formed, communication between them is strengthened. In short, the first type of a nervous system of high solidarity arises—the type which I call *ganglionary*, and of which the higher arthropods are an example.

A delicate question arises here. Where, when, and by what mechanism is the sense of personality formed which inheres in the merides, zoöids and demes—that is to say, the ego?

We have seen that the second property of protoplasm resolves itself into an excitation followed by a reaction. All inquirers do not look at matters in this simple light. A moner or an amœba presents itself to the observer under different aspects. It is immobile and

has its pseudopods more or less extended or contracted; it roams about, impelled by influences wholly beyond our power of detection; it circles round a chance infusory or organic debris which has strayed in its path; and finally, when the latter has come within reach, it lengthens out its pseudopods and seizes it. In these phenomena, which are certainly rather complicated for so simple a being, some observers have seen intention, memory, and will, in a word have discovered in them an ego, obscure though it be. Others have held, and experimentally proved, that the property of performing movements, and particularly of lengthening and shortening pseudopods, can be effected by various physical and chemical agents. Shaking the water in which an amœba is immersed, touching it with a blunt needle, causes slight contraction of the pseudopods, and if the operation is repeated, marked contraction. At a temperature of 35° C. or thereabouts the movements of the amœba are exaggerated to the point of rigidity, below this they are normal, and lower still they are much weakened. Light is without action on amœbas but it causes bacteria and diatomes to run from its presence; a fact, parenthetically, which marks the degrees of development of motility in protists. Among chemical agents some attract, others repel amœbas; some excite, others destroy their movements; anæsthetics have the last effect. Oxygen stimulates their movements and its suppression stops them.

From these effects, to which those due to electricity might be added, it is permissible to conclude that protoplasmic bodies obey in a general manner the same influences that living matter much further up in the scale obeys. But they do not prove that the movements normally produced by natural stimuli, as by the passage of an infusory, are necessarily directed by any sort of centrosome. When a mineral with an avidity for oxygen discriminates and picks out that oxygen in a medium containing nitrogen and carbonic acid, we do not say that it exercises choice. Amœbas have been observed to perform the same movements in engulfing substances unfit for nutrition, such as fragments of hair, for example. An amœba which makes for an object or circles round an infusory, may be simply obeying the excitation which imperceptible disturb-

ances in the water produce. If we attribute an ego to the simplest protists, by way of a preface to the ego which exists in high orders of metazoa, it would be incumbent upon us also to attribute it to sensitive and carboniferous plants, which would certainly be extravagant. And yet, if we grant the existence of individuality in unicellular beings, and that cannot be a subject of doubt, it is difficult to refuse to them a corresponding *sense* of individuality. The preferable course would be to admit that in the kingdom of protists, particularly before their differentiation into protozoans and protophytes, the properties of protoplasmic bodies, viewed singly, are of the physico-chemical order, that life is their result, but that the ego in however infinitesimal a degree we may assume is not yet existent,—in other words, that the movements in question may be classified as mechanical reactions following mechanical excitations. With this reservation, and for brevity of description, we shall not hesitate to make use of the word ego as a synonym for the virtual centre of individuality.

In the initial associations, the cellular individuals being all alike, there is no change. But when groups are formed, collective individualities, having a definite value, are constituted, each being in relation to particular functions of the group. From these spring and are to be distinguished a like number of *partial egos*, which busy themselves only with what immediately concerns them. Those buried in the depths of the aggregate interfere only in the obscure phenomena of digestion. Those which are superficially in contact with the exterior world are incessantly alert. The operations of the one set are restricted to a domain of limited interest, those of the others extend to important organs designed for the capture of prey and for its prehension, for attack and for defence. Naturally the latter attain a greater development. So long as the groups are not united by nervous elements, these egos will remain isolated and will sustain no relations with their neighbors, except through shocks mechanically transmitted from place to place. But as soon as the ganglia have centralised the individuality of each group, and as soon as the nerves have put them in mutual communication, each will take what is its due, a hierarchy will be established and the

responsibilities be divided. There will be the particular interests of each partial ego, and the interests of those charged with the dominant functions and the general welfare. Each will have its independence in its own sphere, but in certain circumstances all will be solidary. Solidarity, however, implies some sort of general and higher ego.

In the generalised ganglionary period, at which we now are, acts are always reducible to an excitation followed by a reaction, but with the three following complications: (1) the conversion of the excitation into movement is no longer effected at the spot but in the nearest ganglion; (2) the ganglion discriminates between the different kinds of excitation and responds by simple or co-ordinated movements varying with the excitation; (3) the excitations occasionally pass beyond the ganglion and spread in greater or less degree to others. Suppose an impression is produced on the antenna of an insect. If it is slight, it will act locally on the cells or tissues, and the extremity of the antenna will wrinkle. If it be increased, it will be reflected to the nearest ganglion, and the antenna and jaws will be set in motion. If it is strong, the entire animal will respond to the reaction. Does an ego intervene in this last case? If the co-ordinated movements have already been produced and repeated under the same conditions and a habit has resulted, then this assumption is useless. But if the impression is novel, if there is occasion for a modification of the act, in a word, if initiative is needed, then necessarily an ego must intervene. But where on this hypothesis is its seat? In one or in several ganglia together? I conclude in several. Morphological unity does not exist as yet in the ganglion of the insect. The insect has its sense of individuality, it discriminates what is parcel of itself from what is extraneous to it. It has its subjectivity, but this subjectivity, its ego, is diffuse. All the facts set forth by Sir John Lubbock in his work on bees and ants, and by other authors who have written on this subject, confirm this conclusion.

At some unknown period in evolution a grand advance is made in the nervous system. A series of ganglia arising from the zoönites of a linear colony are fused into a long cord, the spinal cord of

vertebrates. We know of no living animal limited exclusively to this organ, excepting the larva of the ascidian and amphioxus. But physiological experiments on ordinary vertebrates have indicated what would be its functions. In this hypothetical organism certain impressions will be converted into movements by scattered ganglia in the viscera and along the paths of the nerves; others, more intimately connected with exterior acts, would have their centres of reflex action and of co-ordination in particular zones of the cord; those which play a controlling part and induce modifications of the preceding movements would end in the sensorial ganglionary net of the cephalic extremity of the cord. We say in the net, because everything leads us to believe that the ego is as yet diffused.

The last and greatest progress is accomplished when around the sensory ganglia of the extremity of the cord a proliferation is produced of the cells and nervous fibres, which gives rise to the cerebral hemispheres. Henceforward there is no more doubt, the centralisation of the ego is effected, it has found its true expression; seemingly the ego has been transported from the cord to these new organs, but it is so only in appearance. It is a new ego, *sui generis* and intelligent, that has been formed. The ganglia of the body continue their organic rôles and maintain their petty individualities. The cord fulfils the same functions and also preserves its powerful individuality. The hemispheres are simply a superadded organ—the organ of thought.

Ganglionary animals (Insects, etc.) do not think; they reflect impressions, by associating or not associating under given conditions the action of several ganglia. Animals having hemispheres, that is to say, vertebrates, alone think. Rudimentary thought at its beginning in the lizards of M. Delbœuf, in the crocodiles of the Nile, and in fishes generally; having less value perhaps at this period than apparently it has in certain ganglionary animals; but already reaching considerable heights in the birds and the mammals, attaining its highest in man, and always proportional to the diverse morphological factors of which it is the result! Through it, the ego of the hemispheres intervenes, occasionally, and at its leisure, more or less conscious of its motives of action, suspending, accelerating,

or modifying the co-ordinated acts relating to its exterior life, of which the cord still remains the centre of production. The scattered ganglia have their habits, the results of the repetition of the same acts confirmed by time; the cord has its habits; the hemispheres have also their habits, but of a different kind. The hemispheres alone when their attention is sufficiently solicited, when the interest, pleasure, or caprice of the individual is at stake, and when they will it, are able to alter their own habits and those of the cord. They alone represent the reasoning ego.

It follows from this examination that the ego, such as we have experience of it in ourselves, is the final product of a long evolution which can be reduced to four stages. In the first, or in the solitary cells of the protist kingdom, it existed merely in a potential state. In the second, or in the non-solidarised colonies, it was presented in the form of partial and scattered egos whose sphere was restricted to the special functions with which the group that each represented was clothed. In the third, or in the solidarised colonies of the generalised ganglionary type, it had its seat in a diffuse form in the main regulative ganglia, and as yet furnished but a vague sentiment of general individuality. In the fourth, or in the vertebrates, it is housed in a special organ subsequently superadded; here it had its modest birth, developed little by little, and ended at the summit of the scale by becoming the mighty ego of man.

Virtual, diffused, or centralised, its rôle in all animals is to afford individuals the sentiment of their conservation, of their needs, and to force them to obey the injunctions of nature on penalty of annihilation. In its highest degree it comprises memories of the past, acts, sensations, and thoughts, the sum-total of its internal and external impressions; it gives to the individual the sentiment of its present corporeal existence and the notion even of its faculties and intellectual operations: *cogito ergo sum.* Animals provided with hemispheres alone think; man alone knows that he thinks. The ego is the consciousness of self—it is the soul.

Let us go back to the first law, not of life, but of the conservation of life in individuals, be it protoplasm, cell, meride, zoöid, or deme—the obligation to conform to circumstances, that is to satisfy

their needs while yielding to outward necessity and acting in the best interests of the organism. The partial egos had control of the individual functioning of each group or organ to which they belonged. The diffused ego, predominating in certain ganglia, was charged with more general interests, such as related to the exterior world. The centralised ego was established to look after the same interests but was vested with more authority. This is its whole part. It distinguishes what is external to it from what is within the sphere of its interests. The external world is indifferent to it, according as it does not or cannot affect its existence. It has no other concern but to perceive and foresee. It refers all things to itself; it is zoöcentric, that is to say, egoistic. We cannot conceive of a unicellular or multicellular animal that is not egoistic. It is the very essence of individuals. It remains to be seen whether this egoism cannot assume different forms, and whether it is not subject to differentiation according to the law controlling all properties, functions, and organs.

The acts of animals always involve conservation. In the protoplasm or cell, in the sponge or the polyp, before the nervous elements have made their appearance, it is contained in the good which results therefrom for the organism and in the evil which is avoided thereby. The good is useful to the individual as the bad is harmful. Later, when the first nervous elements have appeared and sensibility has become established, the impressions are distinguished into pleasurable and into painful; all partial egos, be they inward or superficial, are aware of this distinction, each in the matters which concern it. These impressions at a given moment become accentuated, constitute actual feelings of pleasure and pain, and remain henceforward the criterion *par excellence* impelling the animal to act in this or that direction. The diffused ego of crustaceans and of insects, scarce holding predominance in certain ganglia, has certainly no other immediate guide. The ego of the vertebrates centralised in a special organ is in the same predicament: impressions of pleasure and of pain coming from the periphery or awakened in the hemispheres by the recollection of prior impressions are the determining causes of reactions. Here a new factor intervenes.

To avoid immediate pain, to experience immediate pleasure and by means thereof to obey the direct injunctions of the external world has been hitherto the sole motive spring of action. But the ganglia, the spinal cord, and particularly the hemispheres have become complex organs endowed with new properties, the result of differentiation. They no longer restrict themselves to brutally responding to present peripheral sensations. The impression agitates the organism in its entirety, awakens prior impressions which memory has stored up in latent forms; the response need not be that which the impression of the moment demands, but that which awakened prior impressions prefer. We have here an association of impressions as in a different sphere we have an association of ideas. Actions are most frequently the result of such a process. And hence we arrive at a second formula—the shunning of circumstances wherein previously pain was produced and the seeking those in which pleasure was felt. The lizards of M. Delbœuf creep into their keeper's hand in order to find there the agreeable warmth which they have experienced before; they allow themselves to be caressed because the passage of his hand over their rough skin has previously occasioned them pleasure of which they preserve a lively recollection. The crocodile who flees when he sees the stick with which he has been struck, obeys the impression aroused by the present impression and not the present one itself. Animals generally are led thus to approach individuals of their own and other species who have never done them harm and with whom are associated recollections of pleasure. They return to such persons and acquire the habit of doing so. This custom being repeated from generation to generation, a particular sentiment is formed, increases, and the habit thus established becomes a need—the need of living with others, sociability.

A remark as to the advantages procured by this life in common. The animal is less frequently attacked by his habitual enemies; he has a chance of concealing himself in the mass of his fellows in times of danger; one or another of his companions possesses qualities by which he may profit. His interest and pleasure combining to start him on this path, this animal will, unawares to

himself, gradually come to love his comrades. On occasions he will represent to himself their joys and their sorrows, will endeavor to feel and to share them. As the sight or memory of delicious morsels makes his mouth water, so he may be led to shed tears, as seals do. At the right moment he will run to the aid of his fellows, will perhaps forget his own personality to save them, and may be capable by reflex instigation of the most praiseworthy devotion. It signifies little that the habit has grown up progressively without his suspecting it; that the first cause and the secondary causes were the pleasure felt; that the personal interest of the organism was the direct or indirect motive. The unconscious sentiment which responds to it is designated altruism. Sociability and altruism are joint terms. They imply mutual concessions, advantages mutually tendered, and consequently a lessening of egoism. This latter is the love of self, altruism is the love of others, in various but marked degrees.

The difficulty is that the two frequently come into conflict; that personal interest, the first by birth, is of the essence of personality and has anteriorly contracted deep-rooted habits which never lose their hold; that the altruistic habits which are born subsequently are more feeble and less direct; and that in all struggles the first have the advantage. The life of animals like that of man daily offers examples of this conflict. Happily for altruism the animal is extremely spontaneous. He thinks little or only obscurely before acting. He readily abandons himself to secondary automatic impulses. Habits are his second nature, they are multiple and conflicting; the animal obeys the strongest at the moment, according as circumstances favor the one or the other, or as reflexes of this or that character intervene with more or less rapidity. The animal, like man, frequently yields to temptations which can only involve him in pain; sacrifices a useful act for some immediate pleasure. He has his passions, and is subject to all the forms of nervosity, some coming from his egoism, others from his altruism. But when equilibrium has been restored, when the individual has gotten possession of himself again, when he has recovered the sentiment of his conservation, and the memory of the pains and pleas-

ures consequent upon his acts, when he is put in a position to choose,—his ego, that is to say, his true interests, once more regain the upper hand and direct his conduct.

Certain peculiarities of the animal organism of vertebrates reenforce the predispositions to sociability and altruism as just described. One of the most remarkable characteristics of life is its property of extending itself, of propagating itself like the flames of a conflagration, of multiplying, and of never being fully satisfied in this regard. This, properly speaking, is the primal cause of evolution. Every cell increases, every organ augments, every function expands proportionately to its activity. This exuberance in the young, where anabolism predominates over catabolism, to use the jargon of the day, engenders an excess of muscular activity which requires expansion and of which one form is the need of play. Insects often show traces of it; it becomes marked among the fishes and reptiles, and is quite pronounced in birds and mammals. The Felidæ and Canidæ run, gambol, wrestle, caress and maul each other from sheer joy. The life of monkeys is passed almost entirely in play. Although this need diminishes in adults and disappears among the old, it could not help contributing strongly to the formation of groups. The same exuberance of life impels animals to be noisy, if I may so generalise the idea. There is the so-called cry of insects, the croaking of frogs, the singing of birds, and the various means of communication which obtain among animals. But these manifestations of activity on the part of certain organs are contagious through imitation; they draw auditors and solicit admirers. There is no doubt but this factor has contributed largely to establishing *rapprochements*. If we wished to adduce the case of man, the proof would be easy, but it is sufficient to recall to mind the case of birds, of nocturnal carnivora, and of certain monkeys.

The same exuberance of life has resulted in the irresistible need of testing the range of one's power, and of making extensive use of it, of directing one's actions to surrounding things, especially to animated nature, and particularly to one's fellows. This is the impulse of appropriating prey which has been captured, of taking

possession of the caves used for shelter, of the territory of the chase, or of the pasture to which one is accustomed; it is the need of exerting one's authority, of subjecting, of protecting, of reigning, and even of tyrannising.

But if there is exuberance of life and sense of force in some, on the other hand and comparatively there is the sentiment of weakness and the need of protection in others. Indolent, slothful, or really inferior, these feel themselves incapable, less fitted to cope with circumstances, to supply their needs, to defend themselves; they require assistance, protection, participation in groups where they are less isolated. Hence arises the natural division of individuals, as of species, into the strong and the weak, the protectors and the protected, the courageous and the timid, into individuals predisposed to egoism and to combat, and individuals predisposed to altruism and to quietness. This distinction exists in their life as a whole as well as in that of sex. The male is strong and exploits his power, the female is weak and yields in her weakness. These two factors—directing and being directed—are extremely influential in the formation of social groups.

It would be supererogatory to remark how these various springs of action, which are ultimately reducible to two,—the need of affirming and of satisfying one's ego and the need of taking possession of the non-ego,—must necessarily exert a powerful influence on the development in animal societies of likes and dislikes, passions and active or sensitive faculties. Egoism and force engender emulation, the desire to do better and more, self-love, pride, jealousy, hate, the spirit of reprisal. Weakness inspires submission, sympathy, recognition, suffering, fear, love. But we must not enter on this subject, as it would carry us too far.

Let us recapitulate:—egoism is the expression of the centralised ego. It is love of self. The need of a large life, with a maximum of pleasure and a minimum of pain.

Altruism in its general sense is the love of what is outside of self, or, to be more precise, the love of that which promotes, or tends to promote, the welfare of self. Nevertheless, the word in its particular sense applies only to fellow or kindred creatures.

Altruism is a differentiation of egoism. We ought to say—the altruistic *interest.*

To be in connexion with the exterior world, to receive exterior excitations, and to multiply the sources of enjoyment which they afford, is a need of the organism which grows in intensity according as the central sensibility is more developed in the individual and in the species. It leads to the need of living with one's fellows, or to sociability.

To seek assistance and protection, to share difficulties, to desire much and give little, is the characteristic of personal interest. It also leads to association.

The ego and the association of egos are the two poles of evolution. In the merides and zoöids the egos are weakened by the progress of solidarity. In the demes, associating under other conditions and under the name of animal societies, the egos maintain on the contrary almost their entire independence. But is this detrimental to the solidarity? This we shall discover by degrees.

* * *

A few words, before continuing, on reproduction. It is of two kinds—asexual and sexual. In the first, a part of the individual separates by scission or by gemmation ; in the second two elements, differentiated in opposite senses, unite into one. Reproduction by scission is peculiar to individuals formed of a single cell ; it is to be met with, however, among certain merides or zoöids, such as Medusa, Asterias, and Microstoma. In the latter it furnishes the key to the formation of linear colonies. It is maintained in the vertebrates in particular cases and for the multiplication of anatomical elements, like the cells of the epidermis and the cells of the glandular secretions. Reproduction by gemmation is a second stage of asexual reproduction. It is peculiar to the lower invertebrates, where it multiplies individuals, completes colonies, and frequently alternates with sexual generation, which tends more and more to take its place. Sexual reproduction is the definitive stage. It becomes established as the types get fixed and determinate species are constituted. Elementary in some protists, it becomes more common in the lower invertebrates and is generalised in the higher

invertebrates and in the vertebrates. It consists essentially of the co-operation of two different cells, one male and one female, which are blended into one, possessing the combined latent characters of both. From the protozoans to man all gradations of sexual generation are observable.

At first, there are two cells, presenting no appreciable differences, but which meet, exchange parts of their nuclei, and then separate to continue independently their existence and to reproduce by the ordinary process of division met with in unicellular organisms. It would be opportune to ask here, what the utility is of such a union, which apparently effects no change? These two cells, it is asserted, have severally exhausted their capability of division and have nothing left but to die until the exchange which is made rejuvenates them and renders them fit to pursue a new career. In the second stage, two cells, still alike, blend totally and form but one, which reproduces the type of the common parents. Here, some will add, teleologists no doubt, that the divergent characters are neutralised in this manner and that the common characters, being better transmitted, assure the perpetuity of the type. Be it so. But that does not suit with the theory of Weismann that the differences between two copulants alone produce the variations of type which natural selection subsequently makes use of. In the subsequent stages the two cells become gradually differentiated morphologically and take on the characters of their respective sexes. The female is large and passive, the male is small, lively, and flagellate. Subsequently the profound phenomena of fecundation are exhibited and the fecundated ovum pursues its ontogenetic evolution by reproducing in epitomised form the phases through which has passed the phylogeny of its parents.

Here a difficulty arises, touching the conjunction of the two sexual elements. At the start in the metazoa the two reproducers are individuals, differentiated in opposite senses but belonging to the same colony; the distance for meeting is short, chance favored by currents produces the conjunction. For some time, in radiate and lineal colonies, the sexes continue thus united in the same individual, which is styled monœcious. But gradually they get distrib-

uted on different individuals. A succession of cases shows the transitions. Thus, one individual is hermaphroditic and plays in juxtaposition with another the rôle of both male and female simultaneously, and afterwards successively. When in these conditions one of the rôles is weakened, the corresponding genital apparatus becomes atrophied and the individual remains either male or female as the case may be.

All vertebrates to which we limit ourselves, are bisexual. In a very early phase of evolution the female restricts itself to depositing its ova in places where they are afterwards fecundated by the male. Neither the one nor the other is solicitous as to consequences. The young break their eggs as best they can, immense numbers perish for want of care, but the prodigious fecundity of the female compensates the losses. At this point evolution seems to hesitate as to the direction which it will follow. In some fishes and batrachians the male takes charge of the eggs, but this care does not extend to the young. Selection, the supreme judge of the value of the path followed, has pronounced itself against this system. Then appears the second phase in which the responsibility for the eggs and the young falls entirely upon the female. This is evidently the procedure which best assures the perpetuation of the species. Adaptation to necessity has acted wisely. But is there not corresponding to this specialisation of the final phases of reproduction in the female some useful complement, some assistance on the part of the male who has co-operated in the initial operation? In some invertebrates he dies after having fulfilled his task; in the vertebrates he lives. And here intervenes an instinct, a special sentiment, which is to the general function of reproduction what the ego in egoism is to the general function of relation to the external world.

The germ of this instinct is discovered in the fecundation of the very lowest beings. The attraction which leads the female cell to the male cell is visible: the one rests immovable, the other advances towards it, and before union gives evidence by its movements of genuine agitation. In some fishes, less indifferent than the general run, a like agitation called rut or heat is observed accompanied at times by concomitant and diverse physiological phe-

nomena, such as a change of color of their external scaly integument. It leads in some reptiles, and then in all birds and mammals, to the phenomena of copulation.[1] But at this stage is awakened in the female a sentiment of a quite special character and without precedent in the phylogenetic line. There is an obscure presentiment of it in certain reptiles, and it reaches its highest expression in the birds and the mammals. It is the sentiment of the proprietorship of eggs and of the young—*maternal love*, one of the most admirable creations of evolution. A similar sentiment is developed in the male, but obscurely and laboriously, being subject to numerous exceptions here, and varying from zero to perfection. After rut the male becomes attached to the female, protects her, and transfers his cares and affections to the little ones which are born from her. From the sexual union of the two results a family union which generally lasts until the young are able to take care of themselves.

Such, rapidly sketched, are the phases which beginning with the differentiation of the sexes in the first cells have led to their separation in individuals and, in this, from complete indifference to offspring to association in families having in view the training of children. It remains for us to pass on to the facts.

II. THE ANIMAL FAMILY.

Whatever may be our attendant regrets, for the subject is interesting particularly among hymenopterous insects, we shall pass by the invertebrates and confine ourselves to the vertebrates, a province sufficiently vast in itself. Three forms of association are presented to us, the first intermittent, between two individuals of different sexes, with a view to reproduction; the second, eventual, between two or several individuals, with a view to mutual assistance and companionship; the third, temporary or permanent, under the form of assemblages or societies.

We shall commence with the first and devote some space to it.

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[1] Some fishes, it has been observed, already present phenomena of interior fecundation.

The facts involved are of a special nature; they are either mingled with or alternate with those which refer to societies, and they render the latter facts obscure; the family in which they culminate is regarded rightly or wrongly as the foundation—the formative cell, as it has been called—of societies. There are disadvantages attending the separation of the two subjects and there is danger of repetition; but the drawbacks are outweighed by the advantages.

The Fishes come first. They are divided into two groups. The first is that in which the young are born alive and where there is interior fecundation, and the second is that in which the female lays its eggs in some place, selected or not selected, where they are fecundated by the male. The majority of cartilaginous fishes and some bony fishes belong to the first class. The others, which constitute the great majority, belong to the second. Among the first a certain degree of maternal love apparently exists. A female plagiostome has been observed swimming in company with her young, which she would not abandon until they were able to look out for themselves. In the second, considerable variation is noticeable. At first there is complete indifference; the female lays, but evinces no further concern for, her eggs; the male passes over and fecundates them but likewise exhibits no solicitude for their fate. But at times a certain attraction is manifested between the two sexes without copulation. The female when laying her eggs is followed by one or several males. An agitation analogous to that of rut has been observed in the male, its object being either the female or the eggs laid. This rut proceeds so far as to occasion combats between rivals. The male conjointly with the female, or alone, prepares a sort of nest. One or the other, or both, watch over the eggs. I have seen in the aquarium at Naples a fish living with a female companion and even exhibiting extreme jealousy. The most curious case is that of Gasterosteus. It very carefully and by its own exertions constructs a cylindrical nest; to this it conducts a female and expresses its joy while the latter is laying her eggs, whereupon it goes in search of another; it then walls up the entrance to the nest, watches over the eggs until they have been hatched, and defends them against females which visit the place with the intention of de-

vouring them; finally, it takes care of the little ones and does not give them their liberty until they have no longer need of its protection. Other and more astonishing cases still are the following: that of several male Lophobranchii, who harvest the eggs and taking their station directly upon them protect them until they are hatched; that of Hippocampus and Syngnathus in which the eggs are kept in a ventral or caudal pouch; that of two or three species in which the male hatches the eggs in its mouth.

Sent living into the world, or hatched by themselves, the young of fishes, consequently, are abandoned and perish in large numbers on account of lack of care. But the prodigious fecundity of the majority compensates this loss. The salmon lays nearly twenty-five thousand eggs, the sturgeon millions. Finally, diverse tendencies are manifested as regards the care of the young, some species leaving to the mother the reproductive rôle until the very end, and others confiding it to the father. Is it maternal love or paternal love which is destined to gain the ascendency? There is also a quite curious marsupial tendency. Evolution seems undecided as to the most advantageous path to follow.

The anurous Batrachia come next, and after them the urodelous. The first deposit their eggs in the water or in the sand, where they are fecundated in an unknown manner. Incomplete coition is effected in some species, the eggs being fecundated as they are produced. A few special cases must be noted. In the South-American Surinam toad, the male places the eggs on the back of the female, where they sink in and are hatched in tiny cellules. In other anurans, the male winds chaplets of eggs around his legs, and devotes to them the proper care till birth, when the young are abandoned. In *Nototrema marsupialis*, incubation is effected in a special pouch carried on the back of the female. Evolution is again making attempts in different directions. Is it the father or the mother that is to have charge of the eggs? On quitting the oviduct, whither are the eggs to pass? Into a pouch furnished by the male, or into a pouch furnished by the female? Of brooding or sitting here, there is no question.

The Urodela enter a new phase. Here, says Espinas, "the

males fecundate the eggs in the body of the female." Of these eggs, which are laid subsequently, some care is taken by the female; but the male is ignorant of their whereabouts. This, in conjunction with certain facts presented by the anurans and fishes, has led Espinas to a theory which we shall state as follows: When the female lays her eggs, she is relieved, and abandons them without further concern. When the male afterwards approaches, and expends upon them the ardor of rut, he regards them as his own property and takes upon himself the responsibility of their charge.

In the Reptiles, all hesitation is at an end. Fecundation always takes place in the interior, previously to laying, and by copulation. The female lays fecundated eggs; conceals them more or less carefully; but as a rule shows little further concern for them. She believes her task is finished and is not prompted to continue it further. Nevertheless, some females watch their eggs a little, or even sit on them. Some, after hatching, carry their young to a place of safety, or lead them to the water, but afterwards they forsake them. In the trigonocephalous serpents of Martinique, and in the cayman alligator, the female takes care of them for a longer time. In the latter she has been seen to defend them with great fury and has exhibited symptoms of genuine maternal love. As to the male, his rôle is almost entirely limited to copulation. Some reptiles fight at the period of rut; some go in pairs. In certain crocodiles, the male and the female sit in turns. Some males even go as far as to assist the female in hatching. The most instructive case is that of the Iguana. This lizard lives during a portion of the year with the same female and will vigorously defend her against others of his species, as he would his own property. But neither takes charge of the eggs or of the young. They have the sexual passion only. With the rattlesnake it is the same. Male and female wander lovingly about together, embrace at times, but leave their eggs to hatch alone.

To sum up, in the four groups which we have examined, isolated cases exhibit different tendencies, some of which open the way to what is to become habitual in the succeeding groups. Omitting details, the following is the outcome. In the Fishes and the

anurous Batrachia, there is no maternal sentiment, but as an offset there are rudiments of a paternal sentiment, arising from the circumstance that the passion accompanying rut, not being awakened by the female, is expended entirely upon the eggs and tends to be continued in favor of the young. In the urodelan Batrachia and in the Reptiles, copulation changes the situation. The ardor of rut is mutual and engenders a pronounced bilateral sexual sentiment. This moment past, the male takes no heed of the consequences; the female, left to itself, lays the fertilised eggs and takes charge of them, but does not go much farther. The maternal sentiment begins to dawn, but the paternal sentiment is zero.

Here are presented the two branches which have sprung from the reptiles—namely, the Birds and the Mammals; and in these are accentuated and generalised the exceptional cases which have preceded, and which are most favorable for the direction which is now to follow. But before proceeding we must make a digression, in order to assign the precise meaning of the terms which we are to employ.

The phenomena of reproduction in Birds and Mammals are divisible into three acts. In the first, we have rut, copulation, and fecundation, which are consecrated by a more or less intense sexual love. The second is represented by the incubation of the eggs in the case of Birds, and by gestation in Mammals. The female is here either left to herself or lives with the male. In the last case we have the conjugal period, to which corresponds conjugal love. The third stage begins with the birth of the young and continues till the latter are able to take care of themselves. This is the family period. The family is *maternal* when the mother, left entirely to herself, alone has charge of the young; it is *paternal-maternal* when the father associates with the mother; it is *paternal*, if we may call it so, when the male, having several females, is the centre of the family. Espinas has not considered this last distinction. The care taken by the mother being a constant fact without which in the Birds and Mammals it is almost impossible to conceive the young being raised,—we shall reserve the name of family proper for the last two forms.

Family, then, for us, is constituted by the association of three elements: a male, one or several females, and one or several offspring. Its consecration is family love, which is distinguished into maternal love, paternal love, and filial love, to which must be added conjugal love—a legacy of the preceding period.

One word more. In the pages to follow we shall speak only of wild species, roaming at large. Domestication and even simple sequestration in zoölogical gardens frequently produce modifications in the phenomena of reproduction, as they also do, in even greater degree, in the social instincts.

Birds. The specialisation of the sexes has been distinctly effected here. The principal rôle falls to the male in the first period, while in the female is vested the direct responsibility in the third and the second. Let us consider them separately.

The female, in the first period, plays the passive rôle. She is coquettish, but reserved, allows herself to be seduced, abandons herself with grace, is obedient to the male, even when he is fickle, and generally remains faithful to him. Among the exceptions to the last rule are, it is said, certain doves whom the sexual sense absolutely infatuates. In the second period, the laying and even more so the brooding of eggs occupies her whole attention. She is still attached to her spouse, but on the condition that he respects her eggs. If he does not do so, she abandons him and conceals the eggs. In the third period, all is concentrated on one sentiment: care of the loved young ones. The attachment which is still reserved for the spouse is proportioned to the part which he takes in this care. If her spouse leaves her, her devotion, foresight, and ardor in defending her young increases commensurately. The hen is the model type of maternal love. The instinct of brooding is carried so far here that certain females of the eider-duck will plunder one another's nests to obtain more eggs. Her tenacity in sitting, and in covering her unfeathered young in her nest, is sometimes such that she cannot be driven away, as is the case, for example, with the kingfisher. If her eggs be broken or her young die, she will repair again to the male who has abandoned her, or to another, to be fecundated afresh. We may furtively introduce

strange eggs into her nest, and she will care for the young with the same solicitude. She will adopt the orphans of another mother. In a word, the maternal instinct is consolidated in her in its last degree of efficiency, and is one of the marvels of adaptation to ends. Enfeebled forms of these qualities are met with in only a few cases, as for example in the ostrich, the cuckoo, the molothrus, the ringdove, the tetragalle of Australia, and, according to Van Beneden, in the phalarope.

The male, in the first period, on the contrary, plays an active rôle. He chooses his female, fascinates her by his song and by demonstrations of all sorts, gives combat to his rivals, at times in real Homeric style, then copulates upon the spot, or, more frequently, leads her victoriously off. In the subsequent periods, his rôle being optional, his conduct varies. At times he remains with the female and sympathetically shares her labors; at others he basely abandons her in a spirit of contemptible egotism.

Let us follow the first case. During the conjugal period he assists the female in the construction of the nest or does it alone, fetches food, entertains her by his songs, takes turns with her in sitting or even sits alone (Rhea, Phalarope), and shares both her joys and her sorrows. Audubon recounts that *Muscicapa fulva* exhibits great agitation while its female is laying, that it encourages her, and when the operation is finished soars off in her company with great joy. During the family period, the picture is a charming one. Male and female are intimately united in the same sentiment; they vie with each other in their efforts to cause the young to swallow the food which each has furnished; they teach them to fly and to hunt.

In the second case, of the female's abandonment, three degrees are presented. In the first the abandonment is complete and immediate, directly after the male has satisfied his sexual desire or has become exhausted. Examples are the turkey, the pheasant, the prairie-chicken, and in fact the majority of the Gallinaceæ and some stilt-birds and palmipeds. Let us take the turkey. The two sexes habitually live apart. In the spring the female approaches and calls. The male hastens by, abandons himself to all the affecta-

tions accompanying rut, and copulation begins. As soon as the female begins to lay, her sexual desire is extinguished; she gradually withdraws; the male seeks her, exhibits dissatisfaction, is jealous of the eggs, which he seeks to devour and which the female defends. He finally seeks solace in renunciation, retires for a while to recoup his strength, and at last returns to his friends without exhibiting further concern for the female or her young, or rather for his females, as he is polygamous in rut. In the second degree the male prolongs slightly his stay, withdraws from time to time, returns at night, waits until the female has finished laying, and then quits her definitively. Such is the case of the eider-duck and the quail. In the third degree he abandons the female sooner or later, but returns to her when the young are born and have progressed slightly, and then takes upon himself the direction of the family. Examples are the hazel-grouse, the wood-cock, wild duck, and great bustard. I should add that among those of the first degree there are some who return to their female when the young are emancipated and voluntarily remain in her company until the succeeding rut, when the various stages are repeated.

In fact, correct unions—conjugal in the second period and familiary in the third—are the rule among birds. There are divers types. The type Raptores forms intimate unions, but is profoundly egotistical from wildness. Its couples are monogamous, live apart with their young, and savagely repel all attacks on their nests. Again there is the type of several stilt-birds and of palmipeds like the swan; in the latter the family-circle is rigorously closed; all are closely attached to one another; this again is egoism, but it is from excessive mutual love. Further, there is the type of monogamous pigeons, of which the second and third periods are merely a continuation of the sexual period which is always intense. The care here taken of the young seems accessory, a sort of playfulness, and a constant occasion of sexual love; at times in certain of these species the young are greatly neglected. Then there is the type Rhea, the American ostrich, polygamous from rut until the rearing of the young is completed. The last and most widely spread type is met with in the Passeres, Corvidæ, Hirundinidæ, the majority of stilt-

birds and palmipeds, and in some sea-birds. Its most complete expression is found among the parrots. Sexual love, conjugal love, and family love are here blended into a whole and leave hardly anything to be desired.

A few particular cases do not fall under the two preceding categories—namely, the purely maternal family and the paternal-maternal family. One case is that of the tetragalle of Australia in which the eggs are left to themselves and hatch alone. Another is that of Rhea in which the male broods by itself all the eggs laid by its females. That of the ordinary ostrich approaches to this type and deserves a few words in detail. It is polygamous; the females lay their eggs in the sand and conceal them on retiring. During the day when the rays of the sun are strong, they sit on their eggs alternately with the male but irregularly; during the night the latter alone sits. When the young are hatched, all join in taking care of them, but the father, we are assured, exhibits the greatest solicitude. The strangest case is that of a certain number of birds who occasionally or constantly lay eggs in the nests of other species and thus shirk the cares of maternity. Examples are the honey-guide or indicator-bird, the cow-troopial or molothrus, and the cuckoo. We have seen many unnatural males among birds, but unnatural females of the stripe of tetragalle and molothrus are rare. The female of the latter indulges in the most shamefaced polyandry, contracts conjugal unions of no sort, and when moved to lay seeks out in the thicket the nest of some other bird where it deposits its eggs and never again thinks of them. The cuckoo is better off; he has a female and lives with her. The latter lays her eggs in the nests of different other birds but returns from time to time to see whether their foster mother has taken care of them. When the young are able to fly she comes to them with her spouse, calls them, and thereafter both take charge of their education.

The Birds are monogamous or polygamous in the period of rut, but the males who live with their females during the second and third periods are all monogamous. The exceptions are so rare that they hardly count for anything. There are from one to three broods a year; the same couple, as a rule, remain together during the whole

term. Almost always this couple separates when the bringing up of the last brood has been completed. But sometimes they continue their conjugal union until the succeeding rut; frequently this union lasts for years if not indefinitely. Examples of this type are the eagle, *Picus principalis*, and the stork.

The purely maternal or the paternal-maternal family in some exceptional cases breaks up before the young are able to venture from their nests, as is the case with the albatross. Usually it is prolonged until the young are able to take care of themselves, or even until their education is finished, if the return of the sexual desire permits of it. In the species having two or three broods a season, its return in most cases virtually puts a premature end to the family, the double maternal and paternal instinct disappears, the married couple again becoming lovers expel willy-nilly the young from the nest. Two broods, however, may succeed each other in exceptional cases and live on good terms. In the water-hen the young of the second brood fraternise with those of the first and assist their mother.

The young have no desire at first but to get out of the nest and then to prolong their excursions. They make the attempt, fly away, return at night, and end by never coming back at all. They then generally wander about with their brothers, the time varying with the habits of the species, but in all cases they emancipate themselves on the appearance of the sexual desire. From that time on all is ended. Parents and children recognise one another no longer. There is no reminiscence of family sentiment discoverable in them.

To recapitulate, evolution tends towards the most favorable conditions for attaining the ends of reproduction, outlined in the fishes and reptiles and reaching in the majority of birds approximate perfection. It is no longer the isolated male or the isolated female who has charge of the development of the young, either within or without the egg. A contract of union is established between the two agents of reproduction, an association has been effected, a more or less powerful sentiment unites the male to the

female and to their young. The two concur in the work, each according to its organisation.

In both, the initial period is what one would imagine it ought to be physiologically. The ardor of rut is sufficient and moderate in the female, who is passive. It is violent and capable of overturning all obstacles in the male, who is active. In the later periods the mother has the entire direct responsibility, she is equal to her task, and fulfils it with a tenacity and continuity which is marvellous. The instinct corresponding to the two periods is in her as firmly established and consolidated as is necessary. In the same periods a goodly number of males have taken no step forward, have acquired nothing which is useful to the species; but in the grand majority an instinct at once conjugal and familiary is established which leaves little to be desired. On one hand and on the other it is the triumphing of adaptation of means to ends.

There are still, however, a few discouraging features. One is the rapidity with which the sexual needs put an end to the family life, the drawbacks of which affect the second part of the rearing of the young, namely, their education. The cause at fault here is plainly the plurality of broods. For progress to ensue, it is necessary that these should be reduced to one per year. The second point is the mutual forgetfulness of parents and offspring for one another after separation, and particularly when the latter have attained puberty. But the end has been accomplished, some will say; the species has been renewed, the parents have fulfilled their task.

Mammals. The exterior phases of reproduction differ here slightly from those observed in birds. The second period is frequently long, brooding being replaced by gestation. The third period may be divided into three: nursing which concerns the mother only, the interval between this period and that in which the young have become entirely emancipated, which is short, and the time which subsequently elapses before puberty, during which the young are either free or still follow from habit the footsteps of the mother.

Mammals from the point of view of family or of society, as we

shall see later on, may apparently be divided into three groups: first, the lower mammals comprising the Monotremata, the Edentata or Insectivora, and the Marsupialia; secondly, the higher mammals comprising the Ungulata, the Carnivora, and the Monkeys, men forming a class apart; and lastly, the intermediary mammals.

The Monotremata, the Edentata, and the Insectivora are the lowest with regard to family. The armadillo meets a female, copulates and goes his way. The Sorex is little better; the male and female, when not in the period of rut, devour each other whenever they can. Nevertheless, some couples keep together until the period of the young, namely, in the Onithorynchus, the great ant-eater, the hedge-hog, and the mole.

In the marsupials the instinct of maternal love is naturally quite pronounced. Gestation lasts with them about a month, but for a space of six to eight months the young occupy an abdominal pouch where they are entirely in the hands of the mother. In the wombat, however, she ceases to interest herself in them after they have quitted the pouch, but in others she continues to bestow upon them the most assiduous care. The opossum is a model of maternal love. *Phalangista* and *Phascolarctos* carry their young on their back, clinging to their long tails. As to the male, he is indifferent after rut. In the kangaroo the male has been observed to approach and to contemplate with curiosity the young who show their heads from the pouch. In the flying squirrel he assists in forming little families.

The Chiroptera, allies of the Insectivora, are no better with regard to family. Bats copulate and do not seek each other again until the succeeding rut. The mother has sole charge of the little ones, exhibits affection for them, and carries them around clinging to her body. The reappearance of the sexual desire alone puts an end to her maternal love. The Rodentia offer various types, but as a rule these are little favorable to family life and even to the development of maternal functions. The first type is that of the hamster (*Cricetus*). The male repairs to the abode of the female, copulates, lives with her for some time on good terms, and finally

leaves her. The female, five weeks after, bears five or six young, which she fosters for some fifteen days and finally drives away when they are able to take care of themselves. The dormouse (*Myosus*), *Eliomys*, the porcupine, rats and mice, the vole (*Arvicola*) and the lemming (*Myodes*) belong to the same class. With the meadow-mouse or vole, the solicitude of the mother turns to indifference as the young grow able to take care of themselves. A second type is that of the hare; he never abandons his female for the reason that he is always in rut, as is also she, even during gestation. But more scandalous is its behaviour towards its children. There is not a trace of maternal love in the female; she carries her young thirty days, casts her litter of two to five upon the bare ground, cares for them at most but a few days and abandons them, only returning to them when her milk burdens her. A third type is that of the beaver. It presents phenomena similar to those which we have met with in some birds. The male abandons the female after rut, and does not return to her till several months after, when their two to four young have grown large enough to move about (Audubon and Bachman). A fourth type is that of certain squirrels, the male and female of which keep house until their young are able to look out for themselves; these are monogamous. The fifth is that of the rabbit. Each monogamous couple has its burrow into which it suffers no stranger to pass; they never leave each other; the male loves his young as much as he does his female, he carries them, polishes their skin, and teaches them to seek their food. The mother digs a burrow expressly for them.

One of the peculiarities of certain Rodentia is their prodigious fecundity. The number of their young is generally from three to five, sometimes one, and amounting often to as many as ten. The real cause of their fecundity is the frequency of their litters, which is noticeable, for instance, in mice and rats, and which occurs almost every month in certain voles, and seven times or more a year with the rabbit. They are all voluntarily polygamous and polyandrous, copulate a few days after parturition as is the case of the vole, if not immediately, as is the case of the mouse. Furthermore, the young are very soon capable of reproduction: the time being from one

and one-half to two months in the vole or field-mouse. It has been calculated that one couple of the latter can give birth to five hundred individuals in a single year, and a couple of rabbits to the incredible number of one million in four years. The gigantic emigrations of the lemming from Norway and the pest which the invasion of our domestic rabbit visited upon Australia and California are proofs of this.

In marine mammals, the male rarely abandons the female after rut. Still, we meet with troops of old "solitary" males as they are called who have abandoned their progeny before the proper time, as we do also with special troops of adolescent young. Some are monogamous like the walrus and probably the dugong or halicore; the others are polygamous. In the latter, the father, the mothers, and the offspring remain together until the offspring are brought up, and in some, as it seems to me, even after the succeeding rut. The maternal and paternal sentiments in these polygamous families are not highly developed, the male occupying the position of a sultan of a harem who distributes his favors among many. These polygamous, or paternal families, having some social characters, we will consider more in detail in the chapter on "Animal Societies."

While on the subject of aquatic mammals I may mention the sea-otter (*Enhydris*) which is a transitional carnivore. The family intimately united and monogamous. It is composed of the father, the mother, the suckling infants, and the infants of the year preceding. The male caresses the female with his forepaws and plays with the infants. If their infants are taken away from them they weep and groan as do the seals. The mother carries her young in her mouth like the carnivora.

The Ungulata are not very fecund; as a rule they have but one offspring each year. The *Bos frontalis* has but one every two years, and the Aurochs one every three years. The musimon or wild sheep, the Capreolus or roe-buck, have two or three young, the pig three to nine. Some are plainly monogamous, like the reindeer, the gazelle, and according to Audubon and Bachman the buffalo; others are polygamous, particularly during rut, like the Alpine ibex

and the musimon ; others are polygamous to the very end, like the Solidungula and the elephant. The female has the direct charge of the young. When the male abandons her after rut, she frequently forms with other pregnant females a special group. When the moment for casting has arrived she modestly retires aside. Her little one follows her everywhere, she suckles it, leads it to pasture, shows the liveliest affection for it, and defends it with courage. When her spouse shares with her the care of her young she is extremely grateful for it, loves him, and proves her affection for him in a touching manner. In the Capreolus where the union is of a charming character from rut until the termination of the bringing up, the only interruption happens when the female retires for parturition. A few days after, she is seen to return happy and exultant, followed by her little one ; she calls her spouse, who hurries near, abandons himself to joy, caresses his child and its mother and resumes the direction of the family.

But this spectacle is rare. Among the Ruminants the male is most frequently impelled by the sexual instinct alone or by this and the not less striking necessity of commanding, of being master. Conjugal love after rut and family love are luxuries with them. In the Solidungula, and I shall cite particularly the wild ass (*Asinus hemionus*), as soon as the male is capable of reproduction he has but one ambition, that of imitating his father, of gathering round him as many females as possible, and of making himself the head of a troop from which he jealously drives away all young males who are approaching puberty. In the Cervidæ, at times the male lives with the female only during rut, at times he prolongs his amours until the approach of parturition, and again he often remains with her until he has performed all his duties. Thus it is with the reindeer and with Capreolus. In the Capridæ and Ovidæ, the ardor of rut controls the situation and the polygamy is entirely sexual. In the antelopes, the gazelle is monogamous and assisted throughout by the male ; the capricorn is polygamous ; the chamois tarries with the female only during the time of rut, afterwards resuming his solitary life. In the Bovidæ the male prolongs slightly his stay with the female but afterwards departs to associate entirely with his com-

panions, whilst the female and her young join the other females in the general herd.

Among the Pachyderms two examples will suffice. The wild boar or *Sus scrofa* lives with its females during the autumn rut, which lasts for some weeks or for two or three months, resuming afterwards its solitary habits. The female carries its young four and a half months about, and has a litter of from three to nine; she suckles them four and a half months and protects them for some time thereafter. Several litters will follow her at the same time and thus form a little society entirely maternal in character. The elephant is polygamous. He has on an average eight females, but there are reasons for believing that he is attached to one by a sort of preference for a certain period of time. The female is in gestation twenty-two and a half months, has but one offspring, and takes extraordinary care of it. The father is also attached to his offspring, but apparently after the manner of a chief of a polygamous band rather than as a father, which is the rule among the Ungulata.

The Carnivora are less fecund than the Rodentia, but more so than the Ungulata. They are monogamous in the sense that during the period of rut they associate with but one female, and that in the minority of cases where the union persists until the family phase, they have *a fortiori* but one. The mother is often excellent and devoted to her young, but sometimes leaves much to be desired. The wildcat, the puma, and the hyena, for example, quickly abandon their young in the presence of danger or upon the approach of man. The female ordinarily chooses among the males competing for her favor. The male generally abandons the female after rut or continues to live with her for a short time. In the latter case he hunts with her, or they hunt separately, each for itself, like selfish egoists. Some, like the tiger, occasionally run to the assistance of the female when she is defending her young. Among the few cases where family love exists must be classed the lion, the cat, the dingo, the fox, the wolf, and the ichneumon of the Nile. The wolf, however, voluntarily devours his offspring or abandons them in the event of the mother's death. The lion, who is extremely attached to the lioness during the sexual period and the

simple conjugal period, is indifferent to his offspring when they are born. After a little, however, his heart is touched by their mewings, their gambols and caresses, and he becomes a model father. The harmony between the three constituent elements of the family is perfect.

The Monkeys, from whom we here exclude the anthropoids, are the highest of all the mammals in point of family. They are salacious and fickle in the period of rut, but in the end they make good husbands and good fathers. They never abandon their females after rut or before the birth of the young. They are polygamous like the Ungulata and the marine mammals, but despite their polygamy there is no trace, or at least there is but little trace of a need to pose as the head of a troop of females and offspring. Affection plays the highest rôle here. One only of the monkeys is monogamous, the Nyctipithecus and perhaps the Maki. The monkeys have but one offspring, or, by way of exception, twins.

Their maternal love is admirable. Personal witnesses have described traits which are profoundly touching,—of a mother in her last breath thinking of nothing but bringing her infant to a place of safety, imploring the mercy of the hunter with an expression perfectly human, or dying from grief at her loss. The female suckles her infant, carries it in her arms, upon her back, or wound round her body. It prepares its food, caresses and plays with it, gently corrects it, and shows much foresight for its welfare. Paternal love is not less developed. The two parents vie with each other in their attention to their little one, teach it to walk, climb, and to find its food. The father will run to the aid of his offspring in critical moments, and will extricate it from perilous positions. A male arctopithecus has been observed to take his infant from the arm of its mother and to carry it himself for a while. It is not known at what period the young are emancipated, but it is certain that parental affection and care are not limited to the first year, or, in other words, that the family is composed of infants of various ages.

In the Anthropoids the conjugal and family sentiments are the same. All interest centres in ascertaining whether they also are

polygamous or monogamous, and what is the duration of their union.

I can give no opinion regarding the Gibbon (*Hylobates*). Duvancel's account of having seen mothers go to the river bank to wash the faces of their infants in spite of the latters' resistance, proves that maternity here comprehends its rôle. The orang-outang (Simia) affords a peculiarity which is frequent in mammals and which we shall speak of later,—namely, a family disposition different in the adult and in aged males. The old males are reported to abandon their females after rut. The adults, on the contrary, live with her and prolong their union for an unknown time. The family of the orang-outang is composed as follows: of a male, a female, and several young of widely varying ages amounting sometimes, as it has seemed to me, to as many as four litters. The Anthropoids, as we know, have but one offspring. As to the care devoted to this offspring the details are lacking. But when we see in our menageries the passion which the orang-outang has for infants of all kinds, and even for dolls, the delicacy with which they lift them into their arms and caress them, there can be little doubt that they are the same in the savage state. When the time for accouchement comes, the female withdraws. On the gorilla I possess unpublished data, in addition to those already known. The cases reported by negroes of gorillas having been seen with several females do not convince me. For me he is monogamous; he retains the same female in all likelihood indefinitely. He has been seen with one, two, and as many as three offspring at least, of different ages, whom he watches and defends. The chimpanzee is also most likely monogamous. In the case of Savage the family comprised a male, a female, and two infants of different ages. The following passage from Livingstone leaves no doubt concerning one of the species, the Soko: "He lives in society: some ten males together, each having its female. . . . If one seeks to possess himself of the female of another, he is knocked down and beaten by all the other males. . . . When a difficult spot has to be crossed, the father takes the infant in his arms, carries it over, and hands it to its mother."

To sum up, the Mammals, taken as a whole, are disappointing. They offer but rarely that almost ideal spectacle which so often captivates us in birds. Among the lower mammals maternal love has made a great step in advance of the reptiles, the maternal family having been constituted. But the male has remained at the same point; he abandons the female after rut. In the Rodentia progress is restricted to a few who experience the joys of paternal-maternal family life.

Among the Carnivora and Ungulata, to which we must add the marine mammals, matters tend in two opposite directions. In the Carnivora the paternal-maternal family exists; the father takes his share in the care of the young; the sentiment which binds him to his consort has not the purity which is offered us in birds, but is sufficient and accomplishes its end. The lion is the most advanced example of this type, father, mother, and offspring having for one another the tenderest affection.

In the Ungulata and marine mammals the family is paternal-maternal, but with an entirely different character; what was the rare exception has become the rule. Some are polygamous during rut only, as are many birds; but the majority are polygamous during the two other periods. In the last case, however, the spring of action is falsified. It is not a transformation of sexual love into conjugal love and alternately into paternal love which moves the father, but vanity, the desire of being surrounded by underlings, of possessing a troop over which he can exercise unrestricted authority. The number of females, which is at times excessive, and of the young which result from his many unions, proportionately weaken his altruistic tendencies. Some lose here the notion of personal responsibilty and suffer it to be merged in a collective responsibility of the herd. In short, among the Ungulata, the female is what we have seen her to be among the birds, submissive in the first period, an excellent mother, devoted, and courageous in the third, her ardor to fulfil her tasks growing with the more or less complete abandonment of her male. The male on his part experiences the same agitation in rut, offers the same combats to his rivals, but subsequently deports himself differently. At times he deserts his

females with indifference, at times he keeps them by him to lord it over them, at times he restricts his activity to protecting them from afar as an integral member of the herd, and again and by way of exception he still associates with his family, as is the case with the monogamous reindeer and the almost monogamous Capreolus.

The Monkeys seem to be descended from the Ungulata with regard to family, but they have a less marked sentiment of domination, and on the other hand exhibit a decidedly pronounced conjugal and family sentiment. They never abandon their females; they are all good husbands and fathers. The anthropoids differ from these only in the respect that they are monogamous.

It is on the female, in fine, that adaptation has concentrated all its efforts. The maternal family is a necessity, the paternal-maternal family a luxury. Outside of the hours which he devotes to reproduction, the male has always time for living and enjoying his individual life. As to the female, she has among the birds no leisure except in winter, and none at all among the majority of the higher mammals where rut, gestation, and bringing up succeed one another rapidly and without interruption. From the moment she is capable of reproduction the object of her life is one thing—love. She seeks to please her nearest spouse, she loves him and admires him. She loves the eggs on which she broods and the offspring which are born of them; she loves him who has made her a mother and who shares with her her affection for her offspring. What a difference between her and the male, particularly among the mammals! From the beginning it is pleasure which he seeks, frequently without any ulterior motive; later it is satisfaction of his activity, the need of possessing and of dominating. The male is the egoistic element in the association, the female is the altruistic element. If to employ a word which has been much abused, the male is superior to the female in all that touches the functions of outward life, the female is superior to him in all that concerns reproduction. United they form a complete whole—the physiological unit. All this is realised in the monogamous form of the family.

The polygamous form is a contrary deviation of the physiological law. If we regard the male simply as a fecundator, whilst the

female is conceived merely as a layer or bearer, it is admissible that the male should wander from female to female and fecundate as many as possible. But physiology is not of this mind. It shows that it is less important to procreate enormous quantities of young, who will necessarily be exposed to wholesale destruction from lack of care, than to assure the existence and prosperity of a small number. It shows that in the struggle against the causes of mortality the advantage is with those who with the assistance of two parents only, have exhibited the greatest powers of resistance. According as we rise in the scale of vertebrates the fecundity diminishes; the number of eggs or of young which was so large among the fishes is diminished among the reptiles, the birds, and the mammals. But the common care devoted to the progeny is also proportionately augmented. There is no doubt, even leaving man aside, that the male is devoted to his female and to his young in the inverse ratio of their number. To reduce the male to a simple fecundator, a sultan of a harem, a chief of a herd, is to misrepresent the requirements of bringing up and of education. Polygamy runs counter to the end to be obtained. Equality of number between the sexes in the various species is proof that the unions should be made by pairs and not by pluralities.

A physiological difference will explain perhaps this resistance of the mammalian male to the development of the conjugal and family sentiments as compared with birds. In the latter the total time required for hatching is short; the interval which elapses between the termination of rut and the birth of the young is not long enough for the male to contract new habits with his comrades; the love which he cherished for the female continues during brooding and is readily transferred from her to the infants. In the higher mammals, on the other hand, the time between rut and the end of the bringing up is long; the period of gestation, which varies from several months to twenty-two in the elephant, gives rise to a long gap between the love of rut and the birth of the offspring. During this time the male grows unaccustomed to the female and seeks out his old friends. It is true that there is but one litter a year, and that the return of rut, having no relation to the natural termination

of the bringing up of the young, does not put an unseasonable end to the family as is the case with birds.

We have mentioned a dark point in the case of birds—the extremely rapid separation of the offspring and the parents and their subsequent mutual forgetfulness for one another. Is it the same with the mammals? We have cited among birds the case of the water-hen, where two broods of one season fraternise with one another, with the result that the mother is at the head of a considerable flock. The mammals frequently present analogous cases. In the Virginia opossum, says Audubon, there are three litters and more a year. The young of one may still be seen in the abdominal pouch, whilst those of the two others are found running about under the watchful eye of the mother. In the squirrel, the three to seven young of the two annual litters form a troop of from twelve to fifteen following their mother. In Enhydris the family goes about, formed of a father, a mother, and of the suckling young and the semi-adults. In the wild boar the mother moves about with the young of different years. In the orang-outang and the gorilla the mother and father have been met accompanied by young of widely different ages. There is no doubt that in mammals the family shows more tendency to be prolonged than among birds. In the case of the marmot the young pass the whole winter in the same burrow with their parents. Take also the case of the roe-buck (*Capreolus*). Rut takes place in April or in May, gestation lasts from eight to nine months, and the suckling young are three months old when the second rut takes place. These still remain six months with their mother and do not leave her until the birth of another offspring. In the roe-buck, says M. Trouessart, brothers and sisters have been seen to copulate and to remain together throughout their whole life. There are reasons drawn from the social state, to be learned later on, which lead us to believe that between the moment when the young are emancipated, particularly from their mother, and that at which they reach puberty, the bond is less broken than among birds. But what is certain is that in both the first rut breaks definitely this bond, and that among mammals as among birds no

trace of affection survives between parents and young. They no longer recognise one another.

Conclusions. The family, in the vertebrates, is nothing but one of the phases of the reproduction of the species—its outward terminal phase. It solves for animals the problem of the development of individuals during the interval which separates the rupture of the egg from the moment where, being able to take care of themselves, they have only to reach puberty.

Bi-sexual generation, outlined in the highest protozoans, has been pronounced by the accidents of evolution to be the form most favorable to the reproduction of constituted types, that is to say, of species. Instead of leaving the sexes united in one and the same solidarised colonial individual, adaptation obeying the law of specialisation of functions has separated them and lodged them in different individuals. A difficult situation resulted,—that of two individuals having the same rights to the proprietorship of the resultant offspring, and the same physiological obligation of caring for their development. In some invertebrates the question is simplified: the male dies when he has fulfilled his indispensable rôle. In this uncertain epoch in the history of successive creations, where the fishes and the reptiles are born and differentiated, there are traces of hesitation. The hatched eggs perish for want of care in large quantities. Here was the opportunity for selection. The egg having been laid and fecundated, or fecundated and laid, who should assume charge of its outward development—the male or the female? In the birds and the mammals, the solution has been reached,—it is the female. Organic and psychical impulses have been created in her as the result of the law of utility: the best survive, the poorest perish. But seeing that the male does not disappear after having fulfilled his necessary rôle, why is not some use made of him? Analogous impulses to those formed in a female, prompting him to share with her the family burden, are then produced. But we have seen that adaptation has not attained absolutely identical results in the birds and the mammals. In the majority of the former, the male, prompted by a high sensibility, has become an excellent *pater familias.* In the majority of the latter,

adaptation has gone afield; the sensibility of the animal has labored under disadvantages; the egoistic impulse has gained the upper hand over the altruistic impulse. And this stands to reason. The female, passive by nature, has uniformly yielded to sensibility from her earliest origin in the protozoan cells; the male who has been active since the same period has been confirmed in his consciousness of will and of initiative. He has retained the active rôle in rut. He has also remained active in the majority of mammals in the sense of seeking to possess and to have around him as many females as possible. While from a different aspect of the same egoism the Carnivora have become monogamous, the majority of the Ungulata, of the marine animals, and of the monkeys have become polygamous. The goal is thus missing here towards which adaptation has so successfully proceeded in birds. The conjugal union, instead of being an altruistic association having in view reproduction, is the supremacy of the male over one or several females. The family, instead of being confined to one female and to a reasonable number of young which could be reared and protected, is a clan of which the male is the chief. Polygamy in the Ungulata is a digression of adaptation. If it still persists in the Monkeys, it is because it has not been able to regain the straight path. In the anthropoids, it is true, the scene is changed, and these animals have again become monogamous.

It remains for us to see what influence the various groups connected with the family and also the family itself have exercised on the formation of animal societies,—a study which will carry us to the last chapter of this part.

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